

WHAT IS CLAIMED IS:

1. A rare short circuit determining device for determining whether a rare short circuit, which results from 5 the generation of heat exceeding a predetermined value, has occurred in a load circuit, the rare short circuit determining device comprising:

a sensor for detecting a load current, which flows through the load circuit, and for generating a detection 10 signal; and

a determining circuit connected to the sensor for determining whether a rare short circuit has occurred, wherein the determination circuit calculates one of a first parameter and a second parameter every predetermined time 15 interval based on the detection signal, the first parameter relating to a first time period during which the load current exceeds a predetermined reference current value, and the second parameter relating to a second time period during which the load current is less than or equal to the 20 predetermined reference current value, wherein the determining circuit cumulates the calculated one of the parameters every predetermined time interval to calculate a cumulative parameter value and determines whether a rare short circuit has occurred based on the cumulative parameter 25 value.

2. The rare short circuit determining device according to claim 1, wherein the determining circuit is connected to a shutdown circuit for stopping the supply of 30 the load current from a power supply to the load circuit, and wherein the determining circuit controls the shutdown circuit to stop supplying the load circuit with the load current when it is determined that a rare short circuit has

occurred.

3. The rare short circuit determining device according to claim 1, wherein the first parameter is one of 5 joule heat and arc heat that are generated in relation with the first time period in the load circuit, the second parameter is radiated heat radiated from the load circuit during the second time period, and the determining circuit calculates one of the joule heat, the arc heat, and the 10 radiated heat.

4. The rare short circuit determining device according to claim 3, wherein the determining device cumulates the calculated one of the heats to calculate a 15 total heat and determines whether a rare short circuit has occurred based on the total heat.

5. The rare short circuit determining device according to claim 4, wherein the determining circuit 20 determines that a rare short circuit has occurred when the total heat exceeds a predetermined value.

6. The rare short circuit determining device according to claim 5, wherein the determining device adds 25 the joule heat or the arc heat and subtracts the radiated heat when calculating the total heat.

7. The rare short circuit determining device according to claim 6, wherein the determining device is 30 connected to a shutdown circuit for stopping the supply of the load current from the power supply to the load circuit, and wherein the determining circuit controls the shutdown circuit to stop supplying the load circuit with the load

current when it is determined that a rare short circuit has occurred.

8. A method for determining whether a rare short circuit, which results from the generation of heat exceeding a predetermined value, has occurred in a load circuit, the method comprising the steps of:

detecting a load current that flows through the load circuit to generate a detection signal;

10 comparing the load current with a reference current value based on the detection signal;

calculating one of a first parameter and a second parameter every predetermined time interval based on the detection signal, wherein the first parameter relates to a first time period, during which the load current exceeds a predetermined reference current value, and the second parameter relates to a second time period, during which the load current is less than or equal to the predetermined reference current value;

20 cumulating the calculated one of the parameters every predetermined time interval to calculate a cumulative parameter value;

determining whether the cumulative parameter value has exceeded a predetermined cumulative value; and

25 stopping the supply of the load current to the load circuit when the cumulative parameter value exceeds the predetermined cumulative value.

9. The method according to claim 8, wherein the first parameter is one of joule heat and arc heat that are generated in relation with the first time period in the load circuit, and the second parameter is radiated heat radiated from the load circuit during the second time period, wherein

the calculating step includes calculating one of the joule heat, the arc heat, and the radiated heat, the cumulating step includes cumulating the calculated one of the heats and calculating a total heat, and the stopping step includes
5 stopping the supply of the load current to the load circuit when the total heat exceeds a predetermined heat.

10. The method according to claim 9, wherein the cumulating step includes adding the joule heat or the arc
10 heat and subtracting the radiated heat when calculating the total heat.

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